INSECTS OF MICRONESIA
Diptera: Agromyzidae[1]

By KENNETH A. SPENCER
19 REDINGTON ROAD, LONDON, ENGLAND

INTRODUCTION

The only records to date of Agromyzidae in Micronesia are of *Melanagromyza phaseoli* (Tryon) from Guam and Truk, *Ophiomyia lantanae* (Froggatt) from Ponape, and *Pseudonapomyza spicata* (Malloch) from Guam. The material forming the basis for this study consists of 700 specimens, representing six genera and 18 species.

The family Agromyzidae has been studied more thoroughly than any other family of the acalyptrate Diptera. This is accounted for, in part, by the ease in which the adults are bred from immature stages from their conspicuous leaf mines, which aroused much interest among early biologists. It is therefore surprising that even in areas such as western Europe, where a particularly intensive study of the family has been made by numerous workers, many new species are still being discovered. Hendel, working in Vienna, published a comprehensive monograph of the family (1931-1936, Agromyzidae, IN Lindner, Flieg. Palaearkt. Reg. **6**: 1-570), listing some 360 species for the Palaearctic. However, the present total, including Japan, now exceeds 760 species. The experience in Europe shows how easily individual species of these small flies are overlooked despite intensive collecting by specialists. In view of this, caution is clearly called for in drawing conclusions on the absence of a species from a particular island, when there is such a strong possibility that this may be merely the result of incomplete collecting.

The United States Office of Naval Research, the Pacific Science Board (National Research Council), the National Science Foundation and B. P. Bishop Museum have made the survey and the publication of the results possible. Field research was aided by a contract between the Office of Naval Research, Department of the Navy, and the National Academy of Sciences NR 160-175.

I would like to take this opportunity to thank the authorities of Bishop Museum and, in particular, Drs. J. L. Gressitt and L. W. Quate, for their

[1] This represents, in part, Results of Professor T. Esaki's Micronesian Expeditions (1936-1940), No. 116.

assistance during the preparation of this paper. I am also most grateful to Dr. D. Elmo Hardy for the loan of material from the collection of the University of Hawaii. The institutions in which specimens are stored are indicated by the following symbols: US (United States National Museum) and BISHOP (B. P. Bishop Museum). The majority of drawings have been kindly prepared by my wife. The scale line represents 0.1 mm. in drawings of genitalia and 0.5 mm. in all other cases.

ZOOGEOGRAPHY

In order to put the Micronesian Agromyzidae in proper perspective, table 1 gives the world distribution of described species in the six genera represented in Micronesia. It will immediately be noted that *Melanagromyza* has a similarly dominant position in Micronesia as in the Ethiopian and Oriental Regions. Collecting in the Neotropical Region has been extremely fragmentary and the figures given bear little relation to the actual number of species which certainly must occur there.

Table 1.—World distribution of Agromyzidae

	Regions						
	Micronesia	Oriental	Ethiopian, Madagascar	Palaearctic, Japan	Nearctic	Neotropical	Australia
Japanagromyza	3	6	3	6	1	4	1
Melanagromyza	8	30	86	37	25	16	23
Ophiomyia	3	4	14	29	7	7	6
Phytobia	1	15	11	87	52	12	7
Liriomyza	2	6	6	111	35	21	9
Pseudonapomyza	1	3	6	1	2		1

The following comments can be made on this distribution:

Japanagromyza elaeagni. Known hitherto only from Japan, the Bonin population represents a logical extension of its range to the south.

J. eucalypti. This species was described from the Sydney area, Australia. The Palau population probably represents an introduction, together with its hosts, *Eucalyptus* spp. Although the species is known from Java, it has not yet been recorded from New Guinea.

J. insularum. This species appears to be endemic to the Bonins.

Melanagromyza albisquama. This has been recorded in Fiji, Australia, and Indonesia and its occurrence in Palau is a normal extension of its range from the south. It doubtless awaits discovery on New Guinea.

Table 2.—Distribution of Micronesian Agromyzidae

	Micronesian Island Groups										
					Caroline						
	Bonin	Volcano	N. Mariana	S. Mariana	Palau	Yap	Caroline Atolls	Truk	Ponape	Marshall	Gilbert
1. Japanagromyza elaeagni	×										
2. J. eucalypti (with subsp. paganensis*)			×		×						
3. J. insularum*	×										
4. Melanagromyza albisquama					×						
5. M. atomella			×	G†				×			
6. M. boninensis*	×										
7. M. ipomoeavora*				G			×	×			
8. M. metallica	×			×		×					
9. M. phaseoli				G	×	×	×	×			
10. M. proclinata*				G							
11. M. sojae					×		×				
12. Ophiomyia atralis					×	×	×				
13. O. cornuta				G	×	×	×			×	×
14. O. lantanae									×		
15. Phytobia piliseta				×		×					
16. Liriomyza brassicae	×			×							
17. L. palauensis*					×						
18. Pseudonapomyza spicata	×	×		×	×	×	×			×	×

* Described as new.
† Guam only.

M. atomella. It is puzzling that the only confirmed records for this species are from Guam and Pagan (with a doubtful record for Truk), in view of its wide distribution—Japan, Formosa, Indonesia, Ceylon, India, Philippines, New Guinea, and Australia—and it is felt this must represent incomplete collecting.

M. boninensis. The only record of this species is the unique holotype from the Bonins, where it appears to be endemic.

M. ipomoeavora. This appears to be a widespread species on Truk, having been collected several times; the occurrence on Fananu I. shows the distributional link with Guam. This is another possibly endemic species.

M. metallica. This is a widespread tropical species and has been recorded without any significant gap from the Cape Verde Islands to Australia. The Bonin population represents the northern limit of the species.

M. phaseoli. In addition to attacking a wide variety of commercial leguminous crops, this species has been recorded on indigenous host plants in the Philippines and Australia. No doubt it has similar local hosts in Micronesia but its wide occurrence may be partially accounted for by recent distribution by man.

M. proclinata. This seems to be a likely endemic species, with distribution limited to Guam.

M. sojae. This is a common pest of soy beans, and other cultivated leguminous crops; on Java, it also attacks a number of indigenous species of Leguminosae. Its limitation in Micronesia to the Palau Islands suggests a natural extension of its range from Indonesia, though this is a species which might well be artificially introduced by man.

Ophiomyia atralis. The distribution in Palau, Yap, and the Caroline Atolls suggests colonization from Flores, Wallacea, from where the species was described. I have found it recently at Calcutta, Bangkok, and Darwin, Australia.

O. cornuta. This is a Pan-Pacific species, occurring in the Marianas, Carolines, Marshalls, and Gilberts, and also in Hawaii, where it was described as *scaevolae* by Frick and in Fiji, where it was described as *leucolepis* by Bezzi; it also occurs in Indonesia and the Chagos Islands in the Indian Ocean. It is clearly widespread with its food plant, *Scaevola* spp.; its absence in the Bonins, where *Scaevola* is known to occur, is noteworthy.

O. lantanae. Distribution in Micronesia is so far limited to Ponape where the species was introduced in 1948 for lantana control.

Phytobia (Icteromyza) piliseta. The recent discovery of this species in New Guinea suggests this as the possible source of the Yap and Guam populations.

Liriomyza brassicae. The species is represented by long series from the Bonins and Guam. Its limitation to these two regions suggests artificial introduction. The species can occur in great numbers on cultivated cabbage and may have come in from Japan.

L. palauensis. The unique holotype from Palau may represent an endemic species but it is more likely to be an immigrant from one of the possible neighboring source areas.

Pseudonapomyza spicata. This is the second Pan-Pacific species, being represented in all the island groups of Micronesia, and also occurring in Hawaii, Fiji, and Samoa. As two of its main food plants are corn and sugar cane, its wide Pacific distribution must be partly accounted for by interisland trade in these plants.

The six species recorded in the Bonin Islands do not suggest a predominantly Japanese origin as only two of the species occur also in Japan. It is felt that the presence on Truk of only two species can only be explained by inadequate collecting. If widespread species such as *Ophiomyia cornuta* and *Pseudonapomyza spicata,* which almost certainly occur there, have not yet been collected, then it is certain that other less frequent species have also been missed. In view of their greater isolation, an attenuation of the fauna is to be expected in the Marshall and Gilbert Islands but it is somewhat surprising that the only species so far recorded are *O. cornuta* and *P. spicata.*

The significantly larger number of insects occurring in Palau by comparison

with the other island groups of Micronesia seems to suggest conclusively that Palau has been the stepping stone for the majority of species now found in Micronesia. Eight species of Agromyzidae occur in Palau out of the total of 18.

Only five of the Micronesia species are known from New Guinea and four from the Philippines [Spencer, 1962, Pacific Insects **4** (3) : 651]. Yet surprisingly, the 33 species known from Indonesia (Spencer, 1961, Roy. Ent. Soc. London, Trans., 113), beyond the direct source areas, include no less than 10 of the Micronesia species.

Whether the five new species, *Japanagromyza insularum, Melanagromyza boninensis, M. ipomoeavora, M. proclinata,* and *Liriomyza palauensis* are truly endemic species or are immigrant species not yet discovered in their source areas can only be a matter of pure speculation until still further information from these areas becomes available.

The affiliations of the Micronesian Agromyzidae can be conveniently summarized as follows:

Possibly endemic: *J. insularum, M. boninensis, M. ipomoeavora, M. proclinata, L. palauensis.*

Japanese: *J. elaeagni.*

Oriental, Australian: *J. eucalypti.*

Oriental, Pacific: *M. atomella, O. atralis, O. cornuta, P. spicata.*

Ethiopian, Oriental, Pacific: *M. albisquama, M. metallica, M. phaseoli, M. sojae, P. piliseta.*

Cosmopolitan: *L. brassicae.*

Introduced: *O. lantanae.*

SYSTEMATICS

The essential characteristics of the Agromyzidae are as follows:

Only single break in costa, some distance before point where vein R_1 reaches costa; costa extending to R_{4+5} or M_{1+2}; anal cell always present; postverticals divergent (absent only in *Penetagromyza* Spencer); lower fronto-orbitals present, either incurved or reclinate; distinct vibrissa always present; abdomen with six visible segments before genitalia; wing length 1.5 to 4 mm.

A more detailed characterization of the family is given by Frick [1952, Univ. Calif. Pub. Ent., **8** (8) : 339-452], who cites 19 valid world genera. Four additional genera have since been erected: *Carinagromyza* Sasakawa (1953, Kontyû **22** : 24), *Japanagromyza* Sasakawa (1958, Saikyo Univ. Agric., Sci. Rept. **10**: 138-139), *Penetagromyza* Spencer (1959, Roy. Ent. Soc. London, Trans. **111** : 253), and *Irenomyia* Nowakowski (1960, Inst. Zool. Ann. Zool. **23** : 42).

The Agromyzidae are exclusively phytophagous and are known primarily as a family of leaf miners; this aspect of their biology has been fully examined

by Hering (1951, Biology of the leaf-miners. 's-Gravenhage). Numerous species, however, are stem miners, internal stem borers, fruit or root feeders, or gall causers. In the Ethiopian and Oriental Regions, diminutive species of the genus *Melanagromyza* form a distinctive group of epidermal leaf miners; the larvae have specially adapted, serrated mouth hooks and form shallow, silvery mines immediately beneath the epidermis. This group is represented in Micronesia by *Melanagromyza atomella* (Malloch).

KEY TO MICRONESIAN SPECIES OF AGROMYZIDAE

1.	Subcosta developed throughout its length, coalescing with R_1 before reaching costa	2
	Subcosta becoming a fold distally and ending in costa separately and basad of R_1	15
2(1).	Prescutellars well developed (*Japanagromyza*)	3
	Prescutellars lacking	5
3(2).	Halteres uniformly yellowish	4
	Halteres brown below, white above	**1. Japanagromyza elaeagni**
4(3).	Distiphallus ending in long tubule, extending beyond end of sternite 9	**2. J. eucalypti**
	Distiphallus a short, flat process, not reaching end of sternite 9 (fig. 3, *c*)	**3. J. insularum**
5(2).	Antennae conspicuously separated by facial keel. Jowls projecting in front (*Ophiomyia*)	6
	Antennae at most only slightly separated at base (*Melanagromyza*)	8
6(5).	Male with conspicuous, curving vibrissal horn	7
	Male with normal vibrissa	**12. Ophiomyia atralis**
7(6).	Squamal fringe white	**13. O. cornuta**
	Squamal fringe dark, brownish black	**14. O. lantanae**
8(5).	Squamal fringe pale, whitish	9
	Squamal fringe dark, black or brown	12
9(8).	Mesonotum entirely black	**11. Melanagromyza sojae**
	Mesonotum greenish or bluish	10
10(9).	Eye in male with distinct patch of hairs	11
	Eye in male bare	**4. M. albisquama**
11(10).	Pilosity of eye upright	**8. M. metallica**
	Pilosity of eye distinctly proclinate	**10. M. proclinata**
12(8).	Squamal fringe brown, squamae pale, whitish gray	**7. M. ipomoeavora**
	Squamal fringe black, squamae dark gray or black	13
13(12).	Ocellar triangle brilliantly shining black, elongated	**9. M. phaseoli**
	Ocellar triangle less shining, shorter	14
14(13).	Mesonotum matt, brownish black, wing length 1.6 mm	**6. M. boninensis**
	Mesonotum more shining black	**5. M. atomella**
15(1).	Antennal segment 3 with distinct angle at apex	**18. Pseudonapomyza spicata**
	Antennal segment 3 rounded	16
16(15).	Scutellum dark, concolorous with mesonotum	**15. Phytobia (Icteromyza) piliseta**
	Scutellum yellow	17
17(16).	Mesopleura with variable dark area in lower half	**16. Liriomyza brassicae**
	Mesopleura entirely yellow	**17. L. palauensis**

SUBFAMILY AGROMYZINAE

Genus **Japanagromyza** Sasakawa

Japanagromyza Sasakawa, 1958, Saikyo Univ. Agric. Sci. Rept. **10**: 138.

Immediately recognized by presence of only two pairs of dorsocentral bristles, together with either a strongly developed pair of prescutellars or a bristle on fore tibia; other important characters: subcosta joining vein R_1, costa extending to M_{1+2}, frons narrow, ocellar triangle inconspicuous, arista long and largely bare; knob of halteres variable, being either uniformly brown, or yellow, or brown below and yellowish white above.

This genus of 23 known species combines characters found in *Agromyza* Fallén and *Melanagromyza* Hendel and was erected after confirmatory studies on female genitalia.

All of the species which have been bred are leaf miners, the larva forming a conspicuous upper-surface blotch. The genus was erected for four species from Japan but has since been found in all the main zoogeographical regions. One new species and a new subspecies are described below.

1. **Japanagromyza elaeagni** (Sasakawa). (Figure 1.)

Melanagromyza elaeagni Sasakawa, 1954, Shikoku Ent. Soc., Trans. **4** (3): 38.

Japanagromyza elaeagni (Sasakawa), 1958, Saikyo Univ., Agric. Sci. Rept. **10**: 140; 1961, Pacific Insects **3** (2-3): 333-334.

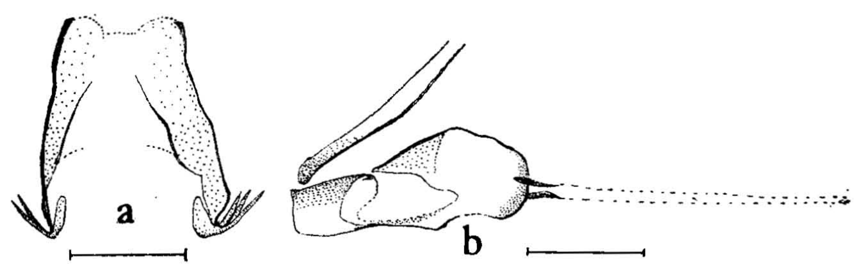


FIGURE 1.—*Japanagromyza elaeagni:* **a**, aedeagal hood; **b**, aedeagus, lateral view.

A rather large species, with wing length up to 2.7 mm.; fore tibia with the strong lateral bristle found in many species of the genus; four strong fronto-orbitals, the lower one incurved, jowls narrow, one-twelfth height of eye; halteres with knobs brownish black below, white above. The species has unique, distinctive spines at base of aedeagal hood (fig. 1, *a*).

DISTRIBUTION: Japan, Micronesia.

BONIN IS.

The larva is known as a leaf miner on *Elaeagnus* spp. in Japan.

2. Japanagromyza eucalypti Spencer.

Japanagromyza eucalypti Spencer, 1963, Australian Mus., Rec. **25** (15): 309.

A small, shining black species with knobs of halteres entirely yellowish white. Genitalia distinctive; aedeagus ends in a long, fine tubule, with a conspicuous, forked, ventral appendage; tergite 9 distinctively pointed, without spines, and cerci not greatly enlarged, as in many species of the genus. (Aedeagus and tergite 9 were illustrated by Spencer, 1963, fig. 1, *a-c*).

DISTRIBUTION: Australia (Sydney), Indonesia (Java), Caroline Is. (Palau).

PALAU. KOROR: Male, three females, Apr. 1957, Sabrosky.

The larva is known in Australia as a leaf miner on *Eucalyptus camaldulensis* Dehnhardt.

2, a. Japanagromyza eucalypti paganensis Spencer, n. subsp. (fig. 2).

Morphologically as in *eucalypti* but mesonotum distinctly more matt and gray. Aedeagus of same general form as *eucalypti* but distiphallus is shorter and ventral appendage more irregular; tergite 9 has two stout, blunt projections; cerci are narrow but conspicuously elongated.

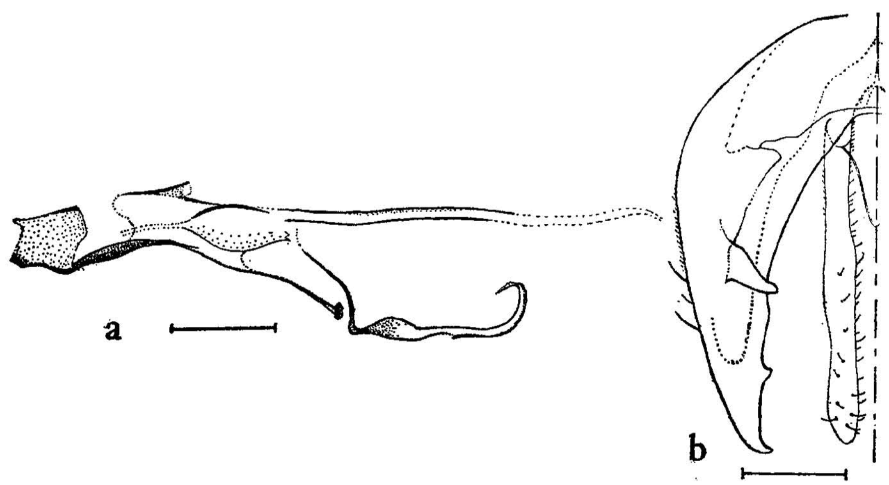


FIGURE 2.—*Japanagromyza eucalypti paganensis:* **a**, aedeagus; **b**, ninth tergite.

DISTRIBUTION: Mariana Is. (Pagan).

N. MARIANA IS. PAGAN: Male, two females, Songsong, Apr. 22, 1940, Yasumatsu and Yoshimura.

The form of the aedeagus and ninth tergite conclusively places these specimens close to *eucalypti*. The differentiation resulting from isolation on Pagan may well have reached specific level but for the time being I prefer to give the specimens subspecific status.

3. Japanagromyza insularum Spencer, n. sp. (fig. 3).

Head: Frons at most equal to width of eye, not projecting above eye in profile. Four fronto-orbitals: upper two equal, relatively long; lower two substantially smaller, the first directed upward, the second inward. Orbital setulae in uniform row, slight, reclinate. Orbits scarcely differentiated; ocellar triangle ill defined, apex extending only slightly beyond upper fronto-orbital. Lunule broad, upper margin forming semicircle, at level of first lower fronto-orbital. Jowls narrow, at most one-twelfth vertical height of eye; cheeks linear; vibrissa strong, equal to lower fronto-orbital. Antennae relatively large, segment 3 rounded, with short, fine pubescence; arista long, only slightly shorter than vertical height of eye, appearing bare.

Mesonotum: Two strong dorsocentrals, second two-thirds length of first, at level of supraalar, a rudimentary third bristle present, little larger than acrostichals. Pair of well-developed, prescutellar bristles present, equal to intraalar. Inner postalar slight, less than half length of intraalar. Acrostichals in eight regular rows, a few hairs extending to prescutellars.

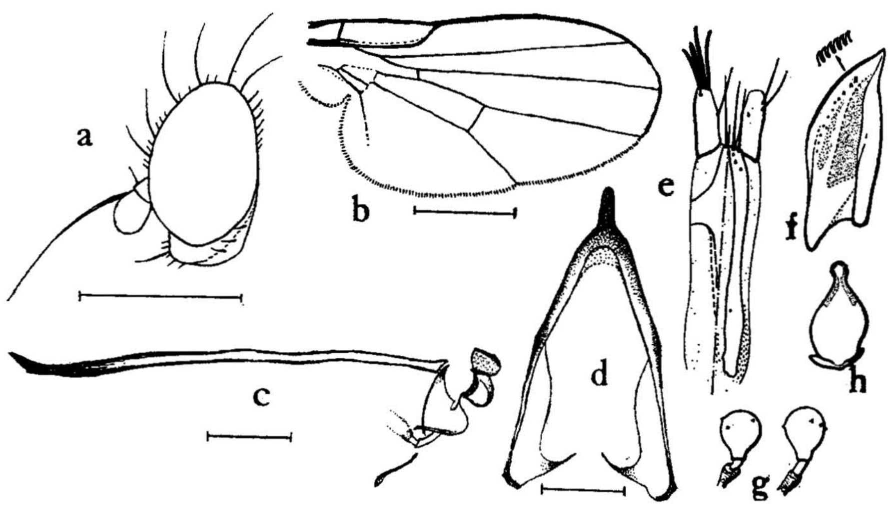


FIGURE 3.—*Japanagromyza insularum:* **a**, head in profile; **b**, wing; **c**, aedeagus, lateral view; **d**, ninth sternite of male; **e**, ninth segment of female, halves of sternite and tergite, dorsal and ventral views of cerci; **f**, egg guide, lateral view; **g**, spermatheca; **h**, ventral receptacle.

Wing: Length in male 2 mm., in female 2.3 mm. Costa extending to M_{1+2}, r-m slightly variable but normally at basal third of discal cell, ultimate section of M_{3+4} two-thirds length of penultimate.

Legs: Mid tibia with two strong posterodorsal bristles, fore tibia with one weaker bristle.

Color: Frons matt black; orbits distinctly shining, ocellar triangle largely matt, only weakly shining; lunule silvery gray. Antennae entirely black. Mesonotum only moderately shining black, distinctly matt; abdomen more shining, entirely black. Legs black, tarsi not lighter. Wings hyaline, veins dark brown. Squamae gray, fringe black. Knobs of halteres whitish yellow, stalks brown.

Male genitalia: Sternite 9 moderately chitinized, distinct hypandrial apodeme black, otherwise pale brown, arms ventrally curved at base; aedeagus weakly chitinized, distal section a flat, oblong process, median section directed ventrally, basal section ovoid, conspicuous epiphallus with two distinct lateral flaps, aedeagal hood large, only slightly less than half length of aedeagal apodeme, surstyli with four rows of 24 stout spines and two longer setae.

Female genitalia: Ovipositor sheath nearly 1.5 times as long as tergite 6, apodeme nearly as long as sheath, pouched on apical one-third. Tergite 9 sclerotized cruciformally, 140 μ long; sternite narrow V-shaped, 200 μ long, bearing two pairs of marginal setae and several sensory setulae; cerci relatively long, each with four long tactile sensillae. Egg guides 240 μ long, each with about 56 minute teeth of serration and about 12 sensillae. Spermathecae minute, 20 by 16 μ, sparsely spinulose, necks about 6 μ, ducts 140 to 200 μ long and 5 μ in diameter. Ventral receptacle weakly chitinized, about 100 μ long, with papilliform tail. (Description and drawings of female genitalia kindly prepared by M. Sasakawa.)

Holotype, male (US 66356), Northeast Bay, Sen-an, Ani Jima, Bonin Is., May 28, 1958, Snyder; allotype, female, same data. Paratypes: Ototo Jima: Male, female, Southwest Bay, Kammuri-Iwa, June 3, 1958, Snyder. Chichi Jima: Three males, two females, Omura, "Camp Beach," May 5-June 9, 1958, Snyder; female, Tatsumi-Wan, Apr. 11, 1958, Snyder; two males, Sakaiura, "Bull Beach," May 12-31, 1958, Snyder.

DISTRIBUTION: Bonin Is.

Genus **Melanagromyza** Hendel

Hendel, 1920, Archiv Naturgesch., Abt. A. **84**: 126.

Subcosta joining vein R_1, cross vein m normally present, normally two strongly developed pairs of dorsocentrals, prescutellars lacking, halteres black or brown.

This is the dominant genus throughout the tropics from the Cape Verde Islands to eastern Indonesia; it accounts for 48 percent of species in the Ethiopian Region and 35 percent in the Oriental Region. Eight of the 18 species represented in Micronesia belong to *Melanagromyza.*

The size ranges from minute epidermal leaf miners with a wing length of 1.5 mm. to stem borers with a wing length of up to 3.5 mm. The adults in many groups are extremely difficult to distinguish; the larvae or puparia, however, frequently reveal striking differences in closely related species (Spencer, 1957, Roy. Ent. Soc. London, Trans. B, **26**: 179-188; 1960, Roy. Ent. Soc. London, Trans. **112**: 15-36). Frequently, species can be more readily separated by a study of the immature stages than by examination of the genitalia.

The genitalia of *M. boninensis* is aberrant, the aedeagus terminating in a pair of conspicuous, rounded flaps; in this respect, the species appears to be related to *M. conspicua* Spencer from the Oriental Region and to the Afro-Asian species, *M. centrosematis* de Meijere. Morphologically these three species are typical of the genus *Melanagromyza* but in the genitalia they show a

close resemblance to certain species of *Ophiomyia*. Further study will be necessary to determine their correct generic placing.

Three new species are described below.

4. **Melanagromyza albisquama** (Malloch). (Figure 4, *a*.)

Agromyza (*Melanagromyza*) *albisquama* Malloch, 1927, Linn. Soc. New South Wales, Proc. **52**: 423-428.

Melanagromyza leguminum Bezzi, 1928, Dipt. Brachycera, Fiji, 166.

Melanagromyza minora Spencer, 1959, Roy. Ent. Soc. London, Trans. 111: 279.

Melanagromyza albisquama (Malloch), Spencer, 1963, Australian Mus., Rec. **25** (15): 311.

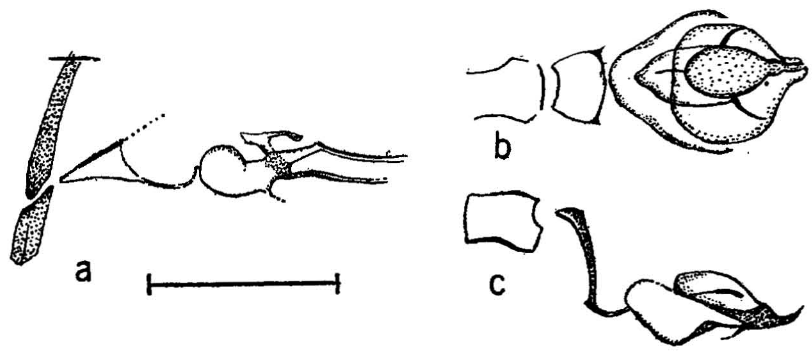


FIGURE 4.—**a**, *Melanagromyza albisquama*, aedeagus. **b**, **c**, *M. atomella*, aedeagus: *b*, from below; *c*, lateral view.

DISTRIBUTION: Cape Verde Is., South Africa, Ceylon, Indonesia (Sumbawa), Australia, Caroline Is. (Palau), Fiji.

PALAU. BABELTHUAP: Two females, Ngerehelong, May, June 1957, Sabrosky; female, Ngiwal, May 1957, Sabrosky; female, Dec. 1952, Beardsley; male, Imeliik, Netkeng, June 1957; male, Oller, May 1953, Beardsley. KOROR: Two females, April 1957, Sabrosky.

This is one of the smallest of the large group of shining greenish species occurring throughout the Old World tropics. Wing length ranges from 1.6 mm. in the male to 2.2 mm. in the female. Other significant characteristics of the species are narrow jowls, at most one-tenth height of eye; large, distinctly shining ocellar triangle, eyes bare in both sexes; arista distinctly pubescent, squamae and fringe whitish.

The distal section of the aedeagus terminates in two paired processes lying one above the other, the upper being longer; the median section is characteris-

tically asymmetrical. The genitalia of the holotype has been examined and is identical with that of the Palau specimen.

The species was described from Fiji where it was bred "from pods of No. 51 C.T.W." It is at least established that the species feeds on Leguminosae but it is unfortunate that the exact food plant was not recorded.

5. **Melanagromyza atomella** (Malloch). (Figure 4, *b, c.*)

Agromyza atomella Malloch, 1914, Mus. Nat. Hungarici, Ann. **12**: 331.

Melanagromyza atomella (Malloch), Hennig, 1941, Ent. Beihefte **8** :174.—Spencer, 1961, Roy. Ent. Soc. London, Trans. **113**: 67-69.

Melanagromyza styricicola Sasakawa, Spencer, 1963, Australian Mus., Rec. **25** (15) : 312.

DISTRIBUTION: India, Ceylon, Japan, Philippines, Indonesia, New Guinea, Australia, Mariana Is.

N. MARIANA IS. PAGAN: Laguna, April 1940, Yasumatsu and Yoshimura.

S. MARIANA IS. GUAM: Two, Ritidian Pt., Oct. 1952, Krauss; six, Yigo, Feb. 1957, Krauss; one, Pt. Oca, light trap, June 1945, Gressitt; two, Pt. Oca, two, Pati Pt., June 1945, Dybas; female, Piti, ex *Morinda,* July 1936, Swezey; seven, Orote peninsula, bred ex leaf mine on unidentified host, Feb. 1936, Swezey; one, Mt. Lamlam, Feb. 1958, Krauss; one, Mt. Chachao, leaf miner, Sept. 1936, Swezey.

This is a small, black, epidermal leaf miner; wing length of the male ranges from 1.4 to 1.9 mm., the female is slightly larger, up to 2.3 mm.

The holotype, caught in Formosa in 1912, is now in the Hungarian National Museum, Budapest. In January 1960, I bred a series from *Passiflora* spp. at Colombo, Ceylon which agree exactly with the holotype. Genitalia of specimens from Ceylon and a male from Guam labeled "leaf-miner on tree" show slight differences; on the other hand, the genitalia of a specimen of an otherwise indistinguishable species from Sumbawa, Indonesia, is obviously different. This is clearly a complex group but it is not considered desirable to establish new species until further bred material is available from confirmed host plants. The host plant, *Morinda* sp. (Rubiaceae) is recorded for only one female of the lengthy series from Guam.

A single female from Truk, Pata, Sabote-Epin, Feb. 1940, Yasumatsu and Yoshimura, is tentatively referred to this species.

6. **Melanagromyza boninensis** Spencer, n. sp. (fig. 5, *a, b*).

Head: Frons broad, 1.5 times width of eye, not projecting above eye in profile. Two upper fronto-orbitals, the posterior one slightly weaker, two weaker lower fronto-orbitals; orbital setulae sparse, reclinate, relatively long, orbits well differentiated. Ocellar triangle conspicuous, extending as furrow to margin of lunule; lunule flat, lower than semicircle, with furrow across center. Jowls narrow, cheeks linear, eye in

male with sparse, scattered hairs. Antennal segment 3 rounded, with short upcurved pubescence; arista long, distinctly pubescent.

Mesonotum: Two strong dorsocentrals, second only slightly weaker than first. Acrostichals in front in eight rows, two rows extending to level of first dorsocentral; intraalar and inner postalar equal, weak, scarcely twice length of acrostichals.

Leg: Mid tibia with one well-defined, posterodorsal bristle.

Wing: Length in male 1.6 mm.; costa extending to M_{1+2} but weaker between R_{4+5} and M_{1+2}; r-m beyond center of discal cell; last section of M_{3+4} two-thirds penultimate.

Color: Entirely black; ocellar triangle and orbits moderately shining; mesonotum distinctly brownish black, matt from front, more shining from behind; wings darkened by coarse microtrichia, veins black; squamae gray, fringe black; halteres black on outside, distinctly paler, brownish, on inside.

Male genitalia: Distiphallus with unique paired, saclike structures, each covered with some 150 minute spinulae, apex of sternite 9 bent downward at right angles to basal section of arms.

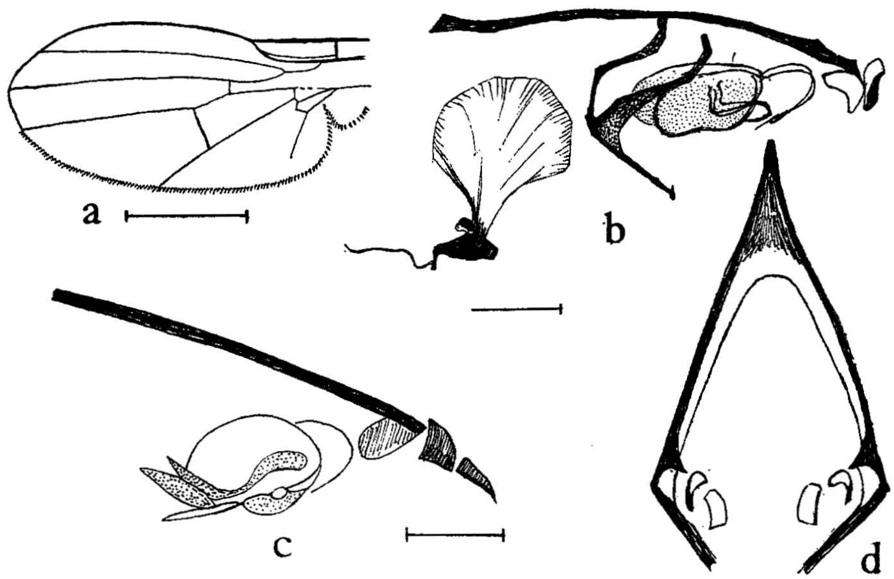


FIGURE 5.—a, b, *Melanagromyza boninensis: a,* wing; *b,* aedeagus, ninth sternite and spermal sac. c, d, *M. ipomoeavora: c,* aedeagus; *d,* ninth sternite of male.

Holotype, male (US 66357), Okimura, Haha Jima, Bonin Is., Apr. 26-May 9, 1958, Snyder.

DISTRIBUTION: Bonin Is. (Haha Jima).

M. boninensis superficially resembles *M. atomella* (Malloch) in size and general morphology. The aedeagus places the species in a well-defined group with *M. conspicua* Spencer (1961, Roy. Ent. Soc. London, Trans. 113) and *M. centrosematis* de Meijere (1940, Tijdschr. Ent. 83: 128-131).

7. **Melanagromyza ipomoeavora** Spencer, n. sp. (fig. 5, *c, d*).

Head: Frons narrow, equal to width of eye viewed from above, not projecting above eye in profile. Four fronto-orbitals, upper two directed upward, lower two weaker, directed predominantly inward; a single row of orbital setulae reclinate except for one or two hairs in front. Orbits well defined, distinctly shining; ocellar triangle conspicuously, though not brilliantly, shining, apex extending to midway between second and third fronto-orbital. Jowls narrow, one-sixteenth vertical height of eye, cheeks linear. Eye in male bare; when viewed in profile eye height: width ratio 24: 15. Antennal segment 3 with conspicuously long pubescence, arista long, four-fifths height of eye, distinctly plumose.

Mesonotum: Two strong dorsocentrals, second two-thirds length of first, acrostichals in eight rows in front, individual hairs extending back to level of first dorsocentral. Legs: Mid tibia with two strong posterodorsal bristles.

Wing: Length in male 2.2 mm.; costa extending strongly to M_{1+2}, r-m at midpoint of discal cell, last section of M_{3+4} only slightly more than half length of penultimate.

Color: Frons dark brown, matt, orbits and ocellar triangle shining black, lunule gray, antennae entirely black. Mesonotum conspicuously shining, blackish blue, abdomen similar. Legs uniformly black. Wings clear, veins dark brown; squamae pale, whitish gray, fringe contrasting, brownish black. Halteres black.

Male genitalia: Aedeagus lightly chitinized, distiphallus a complex of sacs and tubes; sternite 9 relatively elongated, outer margins of arms black, inner margins paler, more membranous; postgonites with narrow, strongly chitinized section below, broader, paler above.

Holotype, male (US 66358), Epinup, Moen I., Truk, Mar. 25, 1949, ex *Ipomoea,* Potts. Paratypes: Male, Agana, Guam, May 15, 1936, Usinger; male, Fananu I., Nomwin, Feb. 17-18, 1954, Beardsley; male, Mt. Teroken, Moen I., 70-80 m., Feb. 1953, Gressitt. Two paratypes in Bishop Museum, one paratype in my collection.

DISTRIBUTION: Mariana Is. (Guam), Caroline Atolls (Fananu I., Nomwin A.), Caroline Is. (Truk).

This species is a leaf miner on *Ipomoea* sp. It is readily recognizable by the characteristic shining bluish coloration of the mesonotum and abdomen and by the brown fringe of the pale squamae. The coloration of the mesonotum is slightly variable, however, and in the specimen from Guam there is less bluish and a more greenish tinge.

8. **Melanagromyza metallica** (Thomson). (Figure 6.)

Agromyza metallica Thomson, 1869, Eugenies Resa, Dipt., 609.

Agromyza similis Lamb, 1912, Linn. Soc. London, Trans. **15**: 344-347.

Melanagromyza similis (Lamb), Bezzi and Lamb, 1926, Ent. Soc. London, Trans. **1925**: 5.

Melanagromyza metallica (Thomson), Spencer, 1959, Roy. Ent. Soc. London, Trans. **111**: 278; 1960, ibid. **112**: 25; 1961, ibid. **113**: 74; 1963, Australian Mus., Rec. **25** (15) : 317.

Recognized by following combination of characters: eye in male with small patch of upright hairs at level of upper fronto-orbitals; arista distinctly pubescent; mesonotum and abdomen shining greenish, with varying traces of coppery coloration; squamae

and fringe white; wing length 2.2 to 2.4 mm. Male genitalia distinctive: aedeagus a complex structure of sacs, tubes, and other processes, the distal section of phallus appearing rough, covered with minute spinulae.

DISTRIBUTION: Africa, Seychelles, Philippines, Indonesia, New Guinea, Australia, Solomons, New Hebrides, Bonin Is., Mariana Is., Caroline Is.

BONIN IS. CHICHI JIMA: Two males, female, Omura, "Camp Beach," May-June 1958, Snyder.

S. MARIANA IS. SAIPAN: Female, Matansha-Calabera, May 1940, Yasumatsu and Yoshimura.

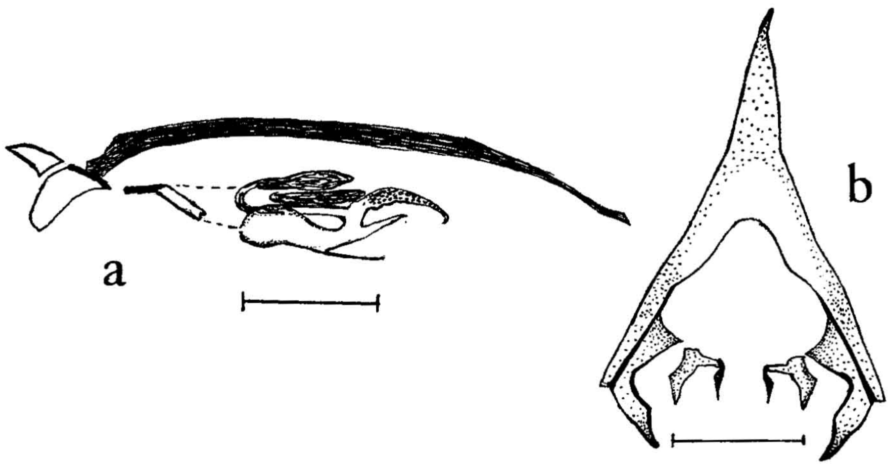


FIGURE 6.—*Melanagromyza metallica:* **a**, aedeagus; **b**, ninth sternite.

YAP. YAP I.: Female, Mt. Gillifitz, 150 m., Nov. 1952, Gressitt; male, female, Gagil Distr., July-Aug. 1950, Goss; female, Ruul, near Kolonia, June 1957, Sabrosky; male, Ruul, near Kolonia, July-Aug. 1950, Goss; female, Oct. 1952, Krauss.

This is one of the complex group of shining green species. It was suggested (Spencer, 1959) that this species feeds in the flower heads of *Inula* sp. In view of the very wide distribution of *metallica* throughout Africa and the Oriental Region to Australia, it is believed that the species feeds in the stems or flower heads of Compositae. Male genitalia of specimens bred from *Inula* in South Africa are distinct from that of *metallica*.

9. Melanagromyza phaseoli (Tryon).

Oscinis phaseoli Tryon, 1895, Nat. Hist. Soc. Queensland, Trans. **1**: 4-7.

Agromyza phaseoli, Coquillet, 1899, Linn. Soc. New South Wales, Proc. **5**: 128-129.

Agromyza destructor Malloch, 1916, Ent. Soc. Washington, Proc. **18**: 93.
Melanagromyza phaseoli (Tryon), Spencer, 1959, Roy. Ent. Soc. London, Trans. **111**: 283-284; 1961, ibid. **113**: 75; 1963, Australian Mus., Rec. **25** (15): 318.

Readily distinguished from all known *Melanagromyza* spp. by the elongated, brilliantly shining ocellar triangle. Frons not projecting above eye in profile, relatively narrow, equal to width of eye; antennal segment 3 with short pubescence, arista bare; two upper fronto-orbitals, the posterior slightly stronger, two weaker lower fronto-orbitals; ocellar triangle strongly shining black, narrow, elongated apex extending almost to posterior lower fronto-orbitals, orbits not raised, but conspicuously shining; cheeks linear; jowls prominent, rounded, one-seventh height of eye; mesonotum and abdomen brilliantly shining black; wing length 2.2 mm.; costa extending to M_{1+2}, r-m at anterior third of discal cell, ultimate and penultimate sections of M_{3+4} in ratio 14: 20, veins pale brown; squamae gray, fringe black.

DISTRIBUTION: Africa, Egypt, Formosa, Philippines, Malaya, Java, Australia, Fiji, western Micronesia, Mariana Is., Caroline Is.

S. MARIANA IS. GUAM.

PALAU. KAYANGEL: Two females, Dec. 1953, Gressitt. BABELTHUAP: Three males, Apr.-May 1957, Sabrosky. KOROR: Male, at light, Apr. 1957, Sabrosky.

YAP. RUMUNG: Female, one sex indet., July-Aug. 1958, Goss. MAP-RUMUNG: Female, one sex indet., Sept. 1939, Esaki. MAP: Four males, two females, July-Aug. 1958, Goss; male, June 1957, Sabrosky. YAP: Two males, three females, July-Aug. 1958, Goss; male, Mar. 1954, Beardsley; female, Oct. 1952, Krauss; female, Giliman, June 1957, Sabrosky.

CAROLINE ATOLLS. SONSOROL: Male, Sept. 13, 1952, Krauss. ULITHI: Two males, female, one sex indet., Falalop, Apr. 1952, Feb. 1953, Beardsley. FAIS: Three males, female, April 1954, Sabrosky; Oct. 1952, Krauss. WOLEAI: Male, Sept. 1952; male, two females, one sex indet., Feb. 1953; seven males, two females, Feb. 1953, Beardsley. IFALIK: Male, Feb. 1953, Beardsley; two females, Sept. 1953, Marston Bates. LAMOTREK: Female, Feb. 1953, Beardsley. NAMOLUK: Male, Nov. 1952, Beardsley. ETAL: Three females, ex *Vigna marina* Merrill, Nov. 1952, Beardsley. SATAWAN: Female, Nov. 1952, Beardsley; one sex indet., Sept. 1952, Krauss. LUKUNOR: Male, Nov. 1952, Beardsley.

TRUK: Female, Pata Sabote-Epin, Apr. 1940; female, Tol Olej-Foup, Apr. 1940, both Yasumatsu and Yoshimura; female, Moen, Feb. 1949, Potts.

Until recently, this species has been credited to Coquillet but, following information received from Mr. Sabrosky, I (1959) credited the species to Tryon, whose valid description antedates that of Coquillet by four years.

M. phaseoli is probably the most serious agromyzid pest. A wide variety of leguminous crops are attacked and complete destruction is not infrequent. The following genera have been recorded as food plants: *Cajanus, Canavalia, Crotalaria, Dolichos, Phaseolus, Soja, Vigna.* The female oviposits in a leaf and the larva forms a short linear leaf mine but quickly enters the stem, where

the main development takes place. Numerous larvae may be found in one plant and with serious infestation the stem turns brown, swells, and breaks open and the plant dies; the puparia remain inside the stem. The biology of the species has been dealt with very fully by Otanes and Quesales (1918, Philippine Agric. **7**: 2-31), Van der Goot (1930, Meded. Inst. Plantenziekt **78**: 1-53), and Hassan (1947, Soc. Fouad ler. Ent. Bull. **31**: 217-224).

Where *M. phaseoli* occurs, it is usually found in large numbers and the absence of records for other parts of Micronesia suggests that its introduction is so far limited to the Carolines and Guam.

10. Melanagromyza proclinata Spencer, n. sp. (fig. 7, *a, b*).

Head: Frons broad, 1.5 times width of eye, not projecting above eye in profile. Two strong, equal upper fronto-orbitals, posterior directed upward and outward, anterior upward; two weaker lower fronto-orbitals directed inward and slightly upward; orbital setulae reclinate, short. Ocellar triangle large, shining, apex extending to anterior upper fronto-orbital, lunule prominent, upper margin rounded, higher than semicircle.

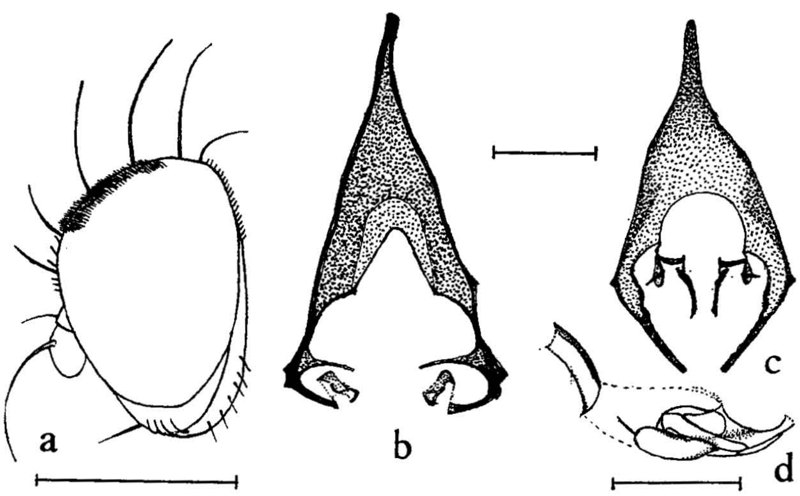


FIGURE 7.—**a, b,** *Melanagromyza proclinata: a,* head in profile; *b,* ninth sternite. **c, d,** *M. sojae: c,* ninth sternite; *d,* aedeagus.

Jowls prominent, forming distinct angle, deepest in front, almost one-tenth vertical height of eye; cheeks forming distinct ring below eye. Eye large, broad, only slightly higher than wide, in male with distinctive, conspicuous patch of thick, proclinate white hairs at level of upper fronto-orbitals, in female eye bare. Antennal segment 3 rounded, with distinct pubescence at upper corner; arista minutely pubescent, appearing almost bare; antennae separated by narrow, sharp keel.

Mesonotum: Two strong dorsocentrals, second 0.75 times length of first; acrostichals fairly regular in 8 to 10 rows in front, individual hairs extending to behind first dorsocentral; intraalar strong, equal to second dorsocentral; postalar little stronger than acrostichals.

Wing: Length in male 2.3 mm., in female 2.4 mm., costa extending strongly to M_{1+2}, r-m at center of discal cell, last section of M_{3+4} in ratio 15: 23 with penultimate.

Legs: Mid tibia with two strong posterodorsal bristles.

Color: Predominantly greenish. Frons, jowls, and face matt blackish brown; orbits and ocellar triangle moderately shining black; lunule more grayish. Mesonotum and abdomen shining greenish, with varying traces of copper, pleura black. Legs entirely black. Wing clear, veins dark, brownish black; squamae whitish, margin faintly darker, brownish, fringe silvery. Halteres black.

Male genitalia: Aedeagus scarcely chitinized, pale, membraneous, indistinct, arms of sternite 9 broadly confluent at apex, pregonites distinctive, laterally elongate; inner and outer processes of postgonites minute, chitinized, joined by pale membrane.

Holotype, male (BISHOP 3260), Inarajan, Guam, Mariana Is., Oct. 1957, Krauss. Paratypes, Guam: Two males, four females, near Ylig Bay, swept in pasture, Nov. 30, 1958; five males, three females, Umatac, Oct. 1957; four males, seven females, Inarajan, Oct. 1957; male, two females, Cocos I., Oct. 1957; all by Krauss. Truk: Two females, Toloas, Jan. 1938, Yoshino; female, Toloas-Erin, Apr. 2, 1940, Yasumatsu and Yoshimura.

DISTRIBUTION: Mariana Is. (Guam), Caroline Is. (Truk).

M. proclinata is distinguished from all other species of *Melanagromyza* by the distinctive proclinate pilosity of the male eye; also by the shape of the jowls, and bare arista.

11. Melanagromyza sojae (Zehntner). (Figure 7, *c, d.*)

Agromyza sojae Zehntner, 1900, De Indische Naturr **11**: 113-137.

Agromyza prolifica Malloch, 1914, Mus. Nat. Hungarici, Ann. **12**: 326.

Melanagromyza sojae (Zehntner), de Meijere, 1922, Bijdr. Dierkunde **22**: 18-19.—Van der Goot, 1930, Meded. Inst. Plantenziekt **78**: 54-68.—Spencer, 1961, Roy. Ent. Soc. London, Trans. **113**: 77; 1963, Australian Mus., Rec. **25** (15) : 320.

Melanagromyza producta Malloch: Spencer, 1962, Notes on the Oriental Agromyzidae—1.

Readily distinguished from all others known from the Oriental Region and the Pacific by its characteristic coloration: mesonotum shining black and abdomen shining greenish. Other essential characters: Frons only slightly wider than eye; ocellar triangle large, distinctly but not brilliantly shining; jowls conspicuous, rounded, one-seventh height of eye; antennal segment 3 round, arista relatively long, virtually bare; eyes bare in both sexes; wing length 2-2.4 mm., r-m normally beyond midpoint of discal cell; squamae and fringe white.

Male genitalia: Sternite 9 with unusually broad arms; outer process of postgonites with a distinct seta; hypandrial apodeme fairly long in specimens from Palau and Fiji, but substantially shorter in one specimen from Formosa.

Posterior spiracles of larva with a characteristic arrangement of six buds on each process encircling a short, black horn (figured by de Meijere, 1922, Bijdr. Dierkunde **22**: 19).

DISTRIBUTION: Egypt, India, Formosa, Java, Flores, Australia, Micronesia, Fiji.

PALAU. NGARUANGL: Male, female, May 9, 1957, Sabrosky.

CAROLINE ATOLLS. TOBI: Male, Sept. 1952, Krauss. MERIR: Female, Sept. 1952, Krauss. SONSOROL: Male, Sept. 1952, Krauss.

The larva of this species is an internal stem borer in Leguminosae, the main hosts being *Glycine soja* Sieb. and Zucc., *Cajanus indicus* L., and *Phaseolus* spp. The species occurs commonly in Formosa and Java, but the damage it causes is slight and infested plants are not killed (Van der Goot, 1930). I have also recently confirmed this species in Fiji.

The species resembles *M. cunctans* (Meigen) from Europe closely, but the differences in arrangement of larval spiracles and in genitalia confirm that the two species are distinct.

Genus **Ophiomyia** Braschnikow

Ophiomyia Braschnikow, 1879, Inst. Agr. Moscow, Ann. **3**: 40.

This genus, comprising 52 described species, is distinguished from *Melanagromyza* Hendel by the prominent facial keel separating the antennae and the jowls normally produced in front, with the vibrissa in the male of most species developed into a conspicuous fascicule or curving horn. The halteres are black in all but one species, *O. aberrans* (Spencer, 1959, Roy. Ent. Soc. London, Trans. **111**: 259; 1960, ibid. **112**: 28), and in the majority the squamae and fringe are dark gray or black, although in two of the three species recorded in Micronesia, *cornuta* (de Meijere) and *atralis* (Spencer), the squamae and fringe are white; there are six other species in this group described from South Africa and Madagascar (Spencer, 1960, op. cit. **112**: 27-31).

12. **Ophiomyia atralis** (Spencer). (Figure 8, *a-c*.)

Melanagromyza atralis Spencer, 1961, Roy. Ent. Soc. London, Trans. **113**: 69.

Ophiomyia atralis, Spencer, 1963, Australian Mus. Rec. **25** (15): 323.

A very small, entirely black species, with a white squamal fringe. Wing length in both male and female is 1.9 mm.; costa extends to vein M_{1+2}. Rounded jowls extend rather far forward; arista short, bare.

Genitalia typical of genus: aedeagus terminates in a paired saclike structure; sternite 9 distinctive with broad arms and a conspicuously broad hypandrial apodeme; postgonites strongly chitinized.

DISTRIBUTION: India, Thailand, Philippines, Indonesia, Australia, Micronesia.

PALAU. ANGAUR: Male, female, Apr. 1958, Sabrosky.

YAP. N. RUMUNG: Female, July-Aug. 1950, Goss. YAP: Male, Mar. 1954, Beardsley; male, W. Yap, July-Aug. 1950, Goss; female, Kolonia, July-Aug. 1950, Goss; female, Nov. 1954, Beardsley; three females, Ruul Dist., July-Aug. 1950, Goss.

CAROLINE ATOLLS. ULITHI: Female, Mogmog I., Oct. 1952, Krauss.

The species was described from two imperfect females from Flores, Indonesia. It has since been found at Calcutta, Bangkok, and Darwin, Australia, as a stem miner in *Vernonia cinerea* Less.

O. atralis is immediately distinguished from the widespread *O. cornuta* by the narrower jowls and the lack of vibrissal horn in the male.

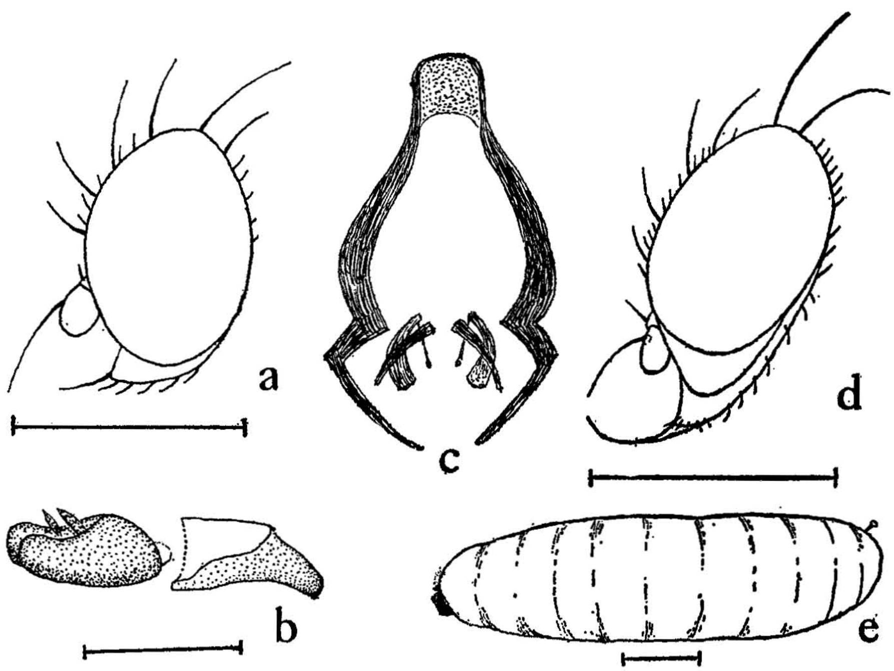


FIGURE 8.—**a-c**, *Ophiomyia atralis: a,* head in profile; *b,* aedeagus, lateral view; *c,* ninth sternite. **d, e**, *O. cornuta: d,* head in profile; *e,* puparium.

13. **Ophiomyia cornuta** (de Meijere). (Figure 8, *d, e.*)

Agromyza cornuta de Meijere, 1910, Tijdschr. Ent. **53**: 161-162.

Agromyza sp., Lamb, 1912, Linn. Soc. London, Trans. **15**: 346.

Ophiomyia leucolepis Bezzi, 1928, Diptera Brachycera, Fiji, 164.

Ophiomyia sp., Frick, 1952, Hawaiian Ent. Soc., Proc. **14**: 515.

Ophiomyia scaevolae Frick, 1953, Hawaiian Ent. Soc., Proc. **15**: 209-210.

Ophiomyia cornuta (de Meijere), Spencer, 1959, Roy. Ent. Soc. London, Trans. **111**: 297.

Readily distinguished by the long, curving vibrissal horn in male, narrow keel separating antennae, and white squamae and fringe; wing length 1.8 to 2 mm.

DISTRIBUTION: Chagos Is., Indonesia, Micronesia, Canton I., Fiji Is.

S. MARIANA IS. SAIPAN: One, Sadog Talofofo, Talofofo area, Feb. 1945, Dybas. GUAM: Four, Santa Rita, Oct. 1957; two, Mt. Alifan, April 1946, Krauss; 16, Umatac, ex *Scaevola,* May 1936, Swezey; six, Cocos I., Oct. 1957, Krauss; six males, eight females, Palm Beach, Dec. 1958, Krauss.

PALAU. NGARUANGL: Three, May 1957, Sabrosky.

YAP. S. YAP: One, July-Aug. 1950, Goss.

CAROLINE ATOLLS. TOBI: Seven, Sept. 1952, Krauss. MERIR: Six, Sept. 1952, Krauss. PULO ANNA: Five, Sept. 1952, Krauss. SONSOROL: One, Sept. 1952, Krauss. NGULU: One, Oct. 1952, Krauss. FAIS: Four, Oct. 1952, Krauss. WOLEAI: 14, Falalis I., Sept. 1952, Krauss; three, Woleai I., Sept. 1952, Krauss. IFALIK: Ifalik I., one, Sept. 1952, Krauss; one, Nov. 1953, Krauss. FARAULEP: One, Pigue I., Sept. 1952, Krauss. NOMWIN: Six, Feb. 1954, Beardsley; three, Fananu I., Feb. 1954, Beardsley; Nomwin I., six, Feb. 1954, Beardsley, one, July 1939, Esaki. SATAWAN: One, Nov. 1952, Beardsley.

KUSAIE. Malem, three, ex *Scaevola,* imago, Feb. 1931, Clarke.

MARSHALL IS. ENIWETOK: 17, Japtan I., Aug. 1956; 12, Jan.-Feb. 1957, Tuthill, seven, May 1956, Townes; 16, Parry I., Aug. 1955, Wheeler. RONGELAP: One, Oct. 1953, Beardsley. WOTHO: Six, Wotho I., Oct. 1953, Beardsley. UJAE: Four, Ujae I., Oct. 1953, Beardsley. KWAJALEIN: Five, Feb. 1958, Krauss; four, Ebeye, Oct. 1953, Beardsley. LIB: Two, Oct. 1953, Beardsley. AILINGLAPALAP: Two, Oct. 1953, Beardsley. NAMORIK: 16, Namorik I., Sept. 1953, Beardsley. EBON: Two, Sept. 1953, Beardsley. MAJURO: One, Uliza I., June 1950, La Rivers; one, Oct. 1953, Beardsley.

GILBERT IS. BUTARITARI: 26, Butaritari I., Dec. 1957, Krauss. MARAKEI: Four, Dec. 1957, Krauss. TARAWA: 18, Maranenuka, Dec. 1957, Krauss; 14, Eret, Dec. 1957, Krauss; 24, Naanika, Nov. 1957, Krauss; 33, Bairiki I., Dec. 1957, Krauss; three, Betio I., Nov. 1957, Krauss; seven, Taborio, Nov. 1957, Krauss; one, Bikenibeu, Nov. 1957, Krauss; three, Banreaba, Nov. 1957, Krauss; one, Eita I., Dec. 1957, Krauss; four, Teaoraeveke, Nov. 1957, Krauss.

O. cornuta has been recorded as a leaf miner on *Scaevola frutescens* (Mill.) Krause and *S. koenigii* Vahl. The puparium, which remains in the mine, is pale whitish; the posterior spiracles are in the form of short black projections, each bearing three buds, lying immediately above the conspicuous, brownish anal projection.

Frick (1953), when describing *O. scaevolae,* suggested that this species might be synonymous with *cornuta* (de Meijere), the type of which he was unable to examine. I have examined the types of both *leucolepis* Bezzi and *cornuta* (de Meijere), and also paratypes of *scaevolae* Frick, which Frick kindly sent me, and established the synonymy given above (Spencer, 1959, p. 297).

14. Ophiomyia lantanae (Froggatt).

Agromyza lantanae Froggatt, 1919, Agric. Gaz. New South Wales **30**: 665-668.

Ophiomyia lantanae (Froggatt), de Meijere, 1925, Tijdschr. Ent. **68**: 253.

DISTRIBUTION: Mexico, Africa, India, Malaya, Australia, Caroline Is. (Ponape), Hawaii.

The adult has a conspicuously bulbous carina separating the base of the antennae, a strong vibrissal horn in the male and the squamae and fringe are black. It is immediately distinguishable on the latter character from *cornuta* (de Meijere) and *atralis* (Spencer).

O. lantanae was introduced into Ponape, Caroline Islands, from Hawaii in 1948 to aid in controlling *Lantana camara* L. As it was present in 1949 it appears to have established itself satisfactorily.

Observations I made at Brisbane, Australia, early in 1961 suggest that the larva feeds by preference in the fleshy receptacle rather than in the hard seed, though sometimes the soft tissues surrounding the seed are attacked. This raises doubts as to the effectiveness of the fly in controlling lantana. The same view was expressed by Subramiam (1934, Indian Jour. Agri. Sci. **4**: 468-470), who investigated the feeding habits of the larva in India.

SUBFAMILY PHYTOMYZINAE

Genus **Phytobia** Lioy

Phytobia Lioy, 1864, Atti Istit. Veneto III, **9**: 1313.
Dizygomyza Hendel, 1920, Archiv Naturgesch., Abt. A. **84**: 130.

Essential characteristics of genus: Subcosta joining costa independently of R_1, orbital setulae reclinate, m present, costa normally reaching M_{1+2}. Great variation in color: frons ranging from yellow to black, scutellum normally dark, differentiating this genus from *Liriomyza.*

Phytobia is a large, diverse genus with 10 well-defined subgenera. It is well represented in the main zoogeographical regions and is the largest genus of agromyzids in North America, with 52 described species. In the Neotropical Region there is a remarkable proliferation of subgenus *Calycomyza* but the number of species has not yet been worked out. In the Oriental Region there are 15 recorded species, making it the second largest genus after *Melanagromyza.* The genus is represented in Australia, New Zealand, and Hawaii. In Micronesia there is a single species, of the subgenus *Icteromyza.*

15. Phytobia (Icteromyza) piliseta (Becker).

Agromyza piliseta Becker, 1903, Zool. Mus. Berlin, Mitt. **2**: 190.

Agromyza pubicornis Lamb, 1912, Linn. Soc. London, Trans. **15**: 344-347.

Phytobia (Icteromyza) piliseta (Becker), Spencer, 1959, Roy. Ent. Soc. London, Trans. **111**: 306.

With yellowish-brown frons, well-defined orbits, shining black mesonotum and abdomen; antennae vary from extreme yellow to almost complete black. Arista conspicuously plumose.

DISTRIBUTION: Southern Europe, Cape Verde Is., Rhodesia, Seychelles (Spencer, 1959), New Guinea, southern Mariana Is., western Caroline Is.

S. MARIANA IS. GUAM: Agana, female, Oct. 1952, Krauss.

YAP. YAP I.: Male, 1952, Krauss; Ruul Dist., male, July-Aug. 1950, Goss.

The variation in color is particularly apparent in these Pacific specimens where one male from Yap and the female from Guam have the third antennal segment bright yellow, whereas in the second male from Yap the third antennal segment is completely black.

The specimens from Micronesia represent an interesting extension of the known range of this species. Two closely related species of the same subgenus, *I. floresensis* Spencer and *I. duplicata* Spencer (1961, Roy. Ent. Soc. London, Trans. **113**), have recently been described from Flores, Indonesia. The food-plant is still unknown.

Genus **Liriomyza** Mik

Liriomyza Mik, 1894, Wiener Ent. Zeitung **13**: 284.

This appears to be the second largest genus of the Agromyzidae but it is very unevenly distributed. There are well over 100 species in the Palaearctic Region. Frick (1959, U. S. Nat. Mus., Proc. **108**: 397) records 35 species for North America, and material I have obtained in South America shows that the genus is also large in the Neotropical Region. In the Ethiopian Region, however, the genus dwindles to 6 species (Spencer, 1959, Roy. Ent. Soc. London, Trans. **111**: 309; 1960, ibid. **112**: 32) and the same number is recorded for the Oriental Region (Spencer, 1961, ibid. **113**). Five species have been recorded in Hawaii, and the same number in New Zealand by Harrison (1959, New Zealand Dept. Sci. Ind. Research Bull. **128**). Although the numbers are small, the percentage of known species represented by *Liriomyza* in those two areas is significantly higher than in the Ethiopian and Oriental Regions.

The genus is distinctive, being characterized by reclinate orbital setulae and a bright yellow scutellum; the great majority of species have a largely yellow head and antennae. The two species occurring in Micronesia are completely typical of the genus.

16. Liriomyza brassicae (Riley).

Oscinis brassicae Riley, 1884, U. S. Dept. Agric., Ann. Rept. (1884), 332.

Liriomyza cruciferarum Hering, 1927, Zool. Jahrb., Abt. Syst. **53**: 461.

Liriomyza brassicae (Riley), Frick, 1952, Univ. California Pub. Ent. **8**: 402.—Spencer, 1961, Roy. Ent. Soc. London, Trans. **113**: 87.

With following combination of characters: Antennal segment 3 and femora entirely yellow; mesopleura largely yellow but with black area in lower half; both vertical bristles on black ground; mesonotum shining black with acrostichals in four rows; orbits normally darkened for varying extent between fronto-orbitals and eye margin.

Orbits may be entirely black from vertex to lower fronto-orbitals or black area may be limited to a narrow line adjoining eye margin, or darkening may be limited to a faint browning on upper orbits in area of upper fronto-orbitals; a few specimens have no darkening of orbits.

DISTRIBUTION: North America, Europe, West and South Africa, Japan, Malaya, Australia, Micronesia, Hawaii.

BONIN IS. CHICHI JIMA: 73, Omura, "Camp Beach," Apr. 1958, Snyder.

S. MARIANA IS. GUAM: 24, Yigo, ex leaf mines on cabbage, Feb. 1955, G. D. Paterson, Jr.

I have bred this species from *Brassica* sp. at Dakar, West Africa, and from *Cleome graveolens* Rabin at Singapore and in both instances, where the identity of the specimens cannot be doubted, some, predominantly female, were obtained with entirely yellow orbits. The same variation occurs in the two series I have studied from Guam and the Bonin Islands.

Frick (1952, Hawaiian Ent. Soc., Proc. **14**: 513) described *L. hawaiiensis* from Hawaii as a leaf miner on various Cruciferae; some paratypes were bred from tomato. The only essential difference between this species and *L. brassicae* is that the orbits of *hawaiiensis* are entirely yellow and the black area on the lower half of the mesopleura is smaller; I have been unable to confirm differences in eye shape mentioned by Frick. It is suggested that a race of *brassicae* may have developed in the Hawaiian Islands with predominantly yellow orbits and it seems doubtful to me that *hawaiiensis* can be accepted as a distinct species.

Two paratypes with entirely yellow orbits which I have examined, bred from tomato, should, in my opinion, be referred to *L. minutiseta* Frick (1952, Hawaiian Ent. Soc., Proc. **14**: 512), the holotype of which was bred from tomato. *L. brassicae* is an oligophagous leaf miner which has been found on numerous genera of the Cruciferae, and commonly on the genera *Cleome* and *Gynandropsis* of the Capparidaceae, but does not feed on Solanaceae. The leaf mine is irregularly linear, upper or lower surface, with the greenish frass deposited in well-defined strips. Pupation takes place outside the mine; the

puparium is pale yellowish, with three buds on each posterior spiracular process.

It seems probable that this species has been introduced to Guam and Chichi Jima with commercial cruciferous crops.

17. Liriomyza palauensis Spencer, n. sp. (fig. 9).

Head: Orbits appear to project slightly above eye in profile (the head in the only available specimen is somewhat deformed and exact form cannot be established); two upper fronto-orbitals equal and directed upward, two predominantly incurved lower fronto-orbitals equal and somewhat weaker than upper; orbital setulae regular, reclinate, in single row from anterior lower fronto-orbitals to posterior upper fronto-orbitals; ocellar triangle short, apex at level of posterior upper fronto-orbitals; antennal segment 3 rounded, with normal pubescence.

Mesonotum: Four dorsocentrals, the anterior two equal, slightly over half length of first (hindmost); second intermediate between first and third; distance between first,

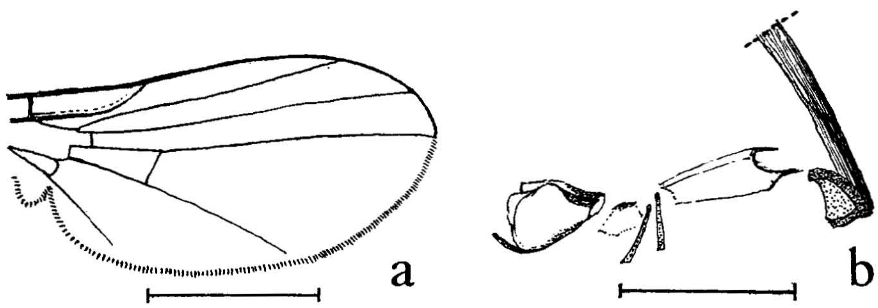


FIGURE 9.—*Liriomyza palauensis:* **a**, wing; **b**, aedeagus.

second and third equal, between third and fourth slightly less. Acrostichals irregularly in four rows, some hairs extending to level of first dorsocentral; inner postalar less than half length of outer, equal to third dorsocentral. Mesopleural bristle with one short hair above and below and also two minute hairs below upper margin of mesopleura.

Wing: Length in male 1.5 mm.; r-m at basal third of discal cell, last section of M_{3+4} twice length of penultimate.

Color: Frons, orbits, jowls, and antennae bright yellow; both vertical bristles on yellow area, hind margin of eye black from base of outer vertical bristle. Mesonotum shining black, with well-defined yellow patches at hind corners, inner postalar at junction of yellow and black; scutellum almost entirely yellow, with all four scutellar bristles on yellow ground, small brown area below bases of basal scutellar bristles. Pleura conspicuously yellow, the only dark areas are a minute brown spot on humeral callus in front of humeral bristle, and brown central areas of sternopleura and hypopleura; mesopleura entirely yellow. Legs: Coxae and femora entirely bright yellow, tibiae and tarsi uniformly dark brown. Abdomen shining black, posterior margins of tergites narrowly yellow; tergites laterally and entire sternites yellowish. Wings normal, veins dark brown. Squamae yellowish, with dark brown borders and ochreous fringe. Halteres yellow.

Male genitalia: Aedeagus distinctive, as illustrated; spermal sac unusually pale, transparent, scarcely detectable.

Holotype, male (US 66359), Ngaiangl, Palau Is., May 9, 1957, Sabrosky.

DISTRIBUTION: Western Caroline Is. (Palau).

The extensive yellow coloration of the thorax and the position of r-m readily distinguish *L. palauensis* from any species described from the Oriental Region or from Hawaii.

Genus **Pseudonapomyza** Hendel

Hendel, 1920, Archiv Naturgesch., Abt. A. **84**: 115.

Characteristic features of this small genus (as defined by Hendel): angle on upper corner of antennal segment 3 and conspicuously short costal segment between veins R_1 and R_{2+3}.

P. spicata (Malloch), described from Formosa, occurs widely in Micronesia. This species is closely related to the type species, *P. atra* (Meigen) from Europe, and both are leaf miners on Gramineae.

Two additional species of this complex, recently described by me, are *P. philippinensis* from the Philippines and *P. asiatica* from India and Singapore (Spencer, 1961, Roy. Ent. Soc. London, Trans. **113**).

18. **Pseudonapomyza spicata** (Malloch). (Figure 10.)

Phytomyza spicata Malloch, 1914, Mus. Nat. Hungarici, Ann. **12**: 334.—Bezzi, 1928, Dipt. Brachycera, Fiji, 167 (as *Pseudonapomyza atra* Meigen.—Malloch, 1935, Ins. Samoa **6** (9): 341.—Swezey, 1946, B. P. Bishop Mus., Bull. **189**: 200.

Pseudonapomyza spicata (Malloch), Hennig, 1941, Ent. Beihefte **8**: 173.—Frick, 1952, Hawaiian Ent. Soc., Proc. **14**: 516-517.—Spencer, 1961, Roy. Ent. Soc. London, Trans. **113**: 93-94.

Malloch's brief description can be amplified as follows:

Head: Frons slightly wider than eye viewed from above, not projecting above eye in profile. One strong upper fronto-orbital directed upward; two weaker lower fronto-orbitals directed inward and upward, a third small seta in front, one-half length of others. Orbital setulae sparse, reclinate. Lunule narrow, semicircular, below plane of frons. Jowls deeply extended at rear, at deepest point 0.25 times vertical height of eye. Antennal segment 3 rounded below, straight above, with characteristic small point at upper corner.

Mesonotum: Three dorsocentrals, first and second strong, equal; third small, half length of second; distance between first and second twice that between second and third; acrostichals strong, irregularly in four rows, extending to first dorsocentrals; inner postalar short, similar to third dorsocentral. Wing: Length in male 1.6 mm., in female up to 1.75 mm.

Color: Frons matt brownish black, orbits similar with slight trace of shine; antennae black; mesonotum conspicuously shining black; legs entirely black; wing normal, R_{2+3}, R_{4+5} strong, brownish black, M_{1+2} and M_{3+4} pale, little more than a fold; wing base brownish; squamae and fringe silvery white, margin not differentiated; halteres white.

Male genitalia: Distal section of aedeagus black, strongly chitinized, basal sclerite forming attachment to aedeagal apodeme quite black; sternite 9 conspicuously pale, arms narrow; spermal sac relatively large.

Puparium: 1.75 mm. by 1.25 mm., entirely pale orange brown, largely matt; segmentation well defined, each segment bearing row of conspicuous papillae which form continuous band from dorsal to ventral surface; papillae longest on anal segment; posterior spiracles widely separated, each conical base bearing an irregular ellipse of some 12 buds, whole spiracular process lightly chitinized; anterior spiracles two short, diverging, fingerlike projections, bearing indeterminate number of buds at apex.

Leaf mine: A linear, upper-surface channel, becoming up to 2 mm. wide at end; frass scattered in conspicuous strips at sides of mine; pupation outside of mine.

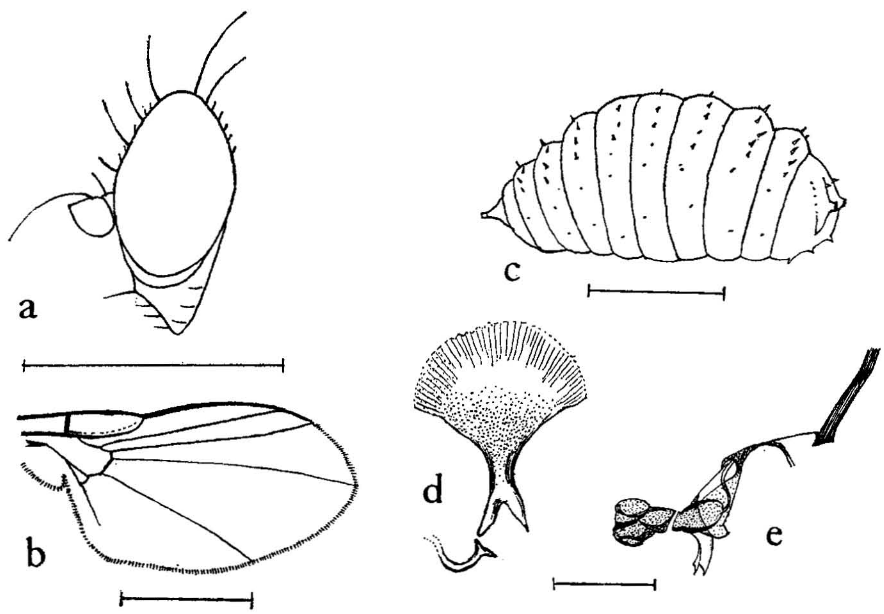


FIGURE 10.—*Pseudonapomyza spicata:* **a**, head in profile; **b**, wing; **c**, puparium; **d**, spermal sac; **e**, aedeagus.

DISTRIBUTION: Formosa, Australia, Micronesia, Hawaii, Fiji, Samoa.

BONIN IS. CHICHI JIMA: Three males, three females, Apr. to June 1958, Snyder; male, at light, May 1956, Clagg.

VOLCANO IS. IWO JIMA: Male, June 1958, Snyder.

S. MARIANA IS. GUAM: Five females, Dededo, ex corn, Nov. 1936, Swezey; 10 males, two females, Piti, on corn, July and Sept., Swezey; one sex indet., Nimitz Beach, Aug. 1952, Krauss; female, Yona, Oct. 1952, Krauss; female, Togcha, May 1945, Bohart and Gressitt; two females, Port Ajayan, June 1945, Dybas.

PALAU. BABELTHUAP: Female, June 1957, Sabrosky. KOROR: Female, Apr. 1957; one sex indet., at light, Apr. 1953.

YAP. YAP: Female, Kolonia, one sex indet., Apr. 1954, Beardsley; two males, Ruul Dist. and Kolonia, July-Aug. 1950, Goss. GAGIL: Male, June, 1957, Sabrosky.

CAROLINE ATOLLS. FAIS: Male, two females, Apr. 1954, Beardsley. LAMOTREK: One sex indet., Feb. 1953, Gressitt. PINGELAP: Male, Jan. 1953, Gressitt.

MARSHALL IS. ENIWETOK: Male, May 1946, Townes. KWAJALEIN: Male, Nov. 1958, Krauss.

GILBERT IS. TARAWA: Male, Betio, Nov. 1957, Krauss.

P. spicata can be separated from *P. asiatica* Spencer and *P. philippinensis* Spencer by the pointed third antennal segment and more shining mesonotum. This species was described by Malloch from specimens collected in Formosa. Specimens identified as *spicata* have since been recorded from Fiji (Bezzi, 1928), Samoa (Malloch, 1935), Guam (Swezey, 1946), and Hawaii (Frick, 1952). It has been established that the species is a leaf miner in corn (*Zea*), sugar cane, and other Gramineae. According to Swezey (1946) up to 100 larvae can infest a single leaf of corn and this infestation results in severe injury to the young plants. I have now examined specimens showing the species to occur throughout Micronesia.